

Damages patterns in historical temples of Puebla, Morelos and Oaxaca after September 2017 Mexico earthquakes

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ABSTRACT

In September 2017, two large-scale earthquakes occurred in Central and South Eastern Mexico, causing serious damages in buildings, homes, schools, old buildings and other kind of structures. The earthquake that occurred on September 7 at 23:49h, local time, in the Gulf of Tehuantepec, caused serious damage in the localities of the states of Oaxaca and Chiapas, near to the region of the Istmo of Tehuantepec. The earthquake of September 19 at 1:14: 40h, with the epicenter on the boundary between the states of Puebla and Morelos, caused damages in Puebla, Morelos, Oaxaca, Guerrero, Mexico City and the State of Mexico. According to official statistics, both earthquakes induced a total of 464 deceased, damages in more than 231,341 homes, 16,136 schools, 83 health buildings and approximately 2000 historic buildings. All with different levels of damage. Partial and total collapses were observed. On the basis of an inspection of the damages, specific in ancient temples, the Institute of Engineering by UNAM performed a special mission to visit the states of Oaxaca, Puebla and Morelos. A total of 58 temples were visited. With the collected information was elaborated a map of the damage patterns, according to the regions, architectural typology and kind of materials. Also, the acceleration records of stations located near to the temples were analyzed to obtain their characteristics and associate them with the damages observed in the temples. For this purpose, modal analysis were performed to obtained the dynamic properties of some temples of the states of Puebla, Oaxaca and Morelos. The great amount of damages in this type of structures was due to the low tension strength of the masonry, the deterioration and an insufficient strength of structural elements to resist earthquakes. Furthermore, inadequate works of retrofitting or modifications that the structure has suffered throughout its history, such as changes in its cover system, among others, that have contributed to increase the damage.